ENGLISH TRANSLATION OF INTERNATIONAL APPLICATION AS ORIGINALLY FILED

DESCRIPTION

Saddle-riding Type Vehicle

Technical Field

[0001] The invention relates to a saddle-riding type vehicle such as a motorcycle.

Background Art

[0002] Conventionally, there is known a saddle-riding type vehicle including a head pipe that supports a steering handle to be capable of moving rotationally, a frame that extends obliquely downward to the rear from the head pipe, and an engine supported by the frame in a suspended state. As the saddle-riding type vehicle of this type, for example, motorcycles disclosed in Patent Documents 1 to 3 described below are known.

[0003] The motorcycle disclosed in the Patent Document 1 includes a head pipe and a pair of left and right main frames that extend obliquely downward to the rear from the head pipe. Brackets are coupled to rear portions of the main frames. An engine is supported by the left and the right main frames and brackets in a suspended state. The motorcycle also includes rear swing arms that support a rear wheel. The rear swing arms are supported by the brackets via a pivot shaft to move up and

down freely.

[0004] Patent Document 1: JP-A-08-067285

Patent Document 2: JP-A-05-330474

Patent Document 3: JP-A-03-330475

Disclosure of the Invention

Problems that the Invention is to solve

[0005] Incidentally, in such a saddle-riding type vehicle, it is desired to reduce weight of a body frame or reduce width of the vehicle while maintaining strength of the body frame. For improvement of convenience in getting on and off the vehicle, it is also desired to keep a portion ahead of a seat low.

[0006] However, in the conventional saddle-riding type vehicle, the engine is supported by the pair of left and right main frames and brackets in an upper part and a rear part of a crankcase of the engine. Consequently, the main frames and the brackets are required to have rigidity that is large to some extent. Therefore, in order to secure rigidity of the main frames and the brackets, it is necessary to increase thickness of the main frames and the brackets. However, when thickness of the main frames and the like is increased, it is difficult to reduce weight of the body frame.

[0007] In the conventional saddle-riding type vehicle, both the engine and the rear swing arms are held between the pair of left and right brackets. Consequently, an interval between

the left and the right brackets is increased and the main frame sticks out in the left to right direction. Therefore, it is difficult to reduce width of the vehicle (a reduction in width in a vehicle width direction).

[0008] Thus, it is an object of the invention to realize a reduction in weight of a body frame while maintaining strength of the body frame in a saddle-riding type vehicle. It is another object of the invention to realize a reduction in width of the vehicle while maintaining strength of the body frame. It is still another object of the invention to keep a portion ahead of a seat of the vehicle low.

Means for solving the Problems

[0009] A saddle-riding type vehicle according to the invention includes: a head pipe that supports a steering shaft to rotationally move freely; a body frame including a main frame that is connected to the head pipe and extends obliquely downward to the rear and a pair of left and right sub-frames that are connected to the main frame and extend obliquely downward to the rear; and a motor supported by the main frame and the respective sub-frames in a suspended state.

[0010] According to the saddle-riding type vehicle, the motor is supported by the main frame and both the sub-frames, whereby the motor is arranged to be laid over the main frame and both the left and the right sub-frames. As a result, since the main frame and the sub-frames are reinforced by the motor, it is

possible to keep strength of the main frame itself or the sub-frames themselves low because of reinforcement by the motor. Therefore, it is possible to realize a reduction in a size or a reduction in weight of the body frame while maintaining strength of the body frame.

[0011] It is preferable that a connecting portion of the main frame and the sub-frames is located ahead of a portion supporting the motor in the main frame.

[0012] Consequently, a portion between a front end portion of the main frame and a portion supporting the motor is reinforced by the sub-frames. Thus, strength of the main frame is improved. Note that a necessary strength distribution of the main frame differs for each vehicle. However, it is possible to make a strength distribution of the main frame suitable or optimum by adjusting a connecting position of the sub-frames to the main frame appropriately.

[0013] It is preferable that the head pipe is connected to a front end side of the main frame and a cross sectional area of the main frame changes along a longitudinal direction of the main frame such that the front end side is larger than a rear end side.

[0014] Note that the change in the cross sectional area of the main frame may be continuous or stepwise along the longitudinal direction of the main frame. A form of the change in the cross sectional area is not specifically limited.

[0015] Consequently, the main frame is formed relatively thick on the front end side connected to the head pipe. Thus, it is possible to secure larger strength of the main frame against bending moment. On the other hand, since the rear end of the main frame is formed relatively thin, when a body cover on a front side of the seat is arranged above the rear end of the main frame, it is possible to keep the body cover low.

[0016] It is preferable that the main frame supports the motor at the rear end of the main frame.

[0017] Consequently, it is possible to reduce length of the main frame.

[0018] It is possible that the sub-frames are bent convexly downward and support the motor at least in one place near bent portions.

[0019] Consequently, the motor functions as a reinforcing member to increase strength of the bent portions of the sub-frames. Since the strength of the sub-frames increases, it is possible to realize a reduction in a size or a reduction in weight of the sub-frames. Since it is possible to reduce a size of the sub-frames, it is possible to keep the body cover on the front side of the seat low.

[0020] It is preferable that the sub-frames are bent convexly downward and support the motor at least in one place further on a rear side than the bent portions.

[0021] Consequently, the motor functions as a reinforcing

member and strength in portions further on the rear side of the bent portions in the sub-frames increases. Since the strength of the sub-frames increases, it is possible to realize a reduction in a size and a reduction in weight of the sub-frames. Since it is possible to reduce a size of the sub-frames, it is possible to keep the body cover on the front side of the seat low.

[0022] It is preferable that the saddle-riding type vehicle includes: a rear wheel; and rear arms that support the rear wheel and extend substantially in a front to rear direction, the sub-frame is bent convexly downward, and both a part of the motor and the rear arms are supported at the rear ends of the sub-frames.

[0023] Consequently, since a part of the motor is supported together with the rear arms, it is possible to simplify a supporting structure for the motor and the rear arms. Since the motor and the rear arms are supported together, in using brackets for support, it is possible to reduce a size of the brackets compared with a case in which the motor and the rear arms are supported separately. Since it is possible to reduce a size of the brackets in this way, it is possible to increase strength of the entire body frame.

[0024] It is preferable that the sub-frames are bent convexly downward and the saddle-riding type vehicle further includes rear side frames that are connected to a portion further on

the rear side than the bent portions of the sub-frames and extend obliquely upward to the rear.

[0025] Consequently, the rear side portions of the sub-frames are reinforced by the rear side frames. It is possible to reduce a size of the sub-frames because the sub-frames are reinforced. Thus, it is possible to keep the body cover on the front side of the seat low.

[0026] The saddle-riding type vehicle may include plural rear side frames that are connected to the rear ends of the sub-frames, respectively, to extend obliquely upward to the rear and are connected to one another.

[0027] Consequently, the rear side portions of the sub-frames are reinforced by the plural rear side frames connected to one another. Thus, strength of the sub-frames increases. Therefore, it is possible to realize a reduction in a size or a reduction in weight of the sub-frames. It is possible to keep the body cover on the front side of the seat low through the reduction in a size of the sub-frames.

[0028] It is preferable that the sub-frames support the motor at least in one place near connecting portions to which the rear side frames are connected.

[0029] Consequently, a part of the motor is supported by portions reinforced by the rear side frames in the sub-frames. Thus, it is possible to realize a reduction in a size or a reduction in weight of the sub-frames themselves. Since it

is possible to reduce a size of the sub-frames, it is possible to keep the body cover on the front side of the seat low.

[0030] It is preferable that the motor consists of an internal combustion engine having a crankcase and a cylinder that extends forward or obliquely upward to the front from the crankcase, the cylinder is supported by the main frame, and the crankcase is supported by the sub-frames.

[0031] Consequently, since the cylinder located on the front side of the motor is supported by the main frame and the crankcase located on the rear side of the motor is supported by the sub-frames, the motor is supported by the main frame and the sub-frames in a well-balanced state. Thus, it is possible to form the main frame and the sub-frames in appropriate lengths and form the main frame relatively short. Therefore, it is possible to realize a reduction in a size and a reduction in weight of the body frame while securing strength of the body frame.

[0032] It is preferable that the cylinder extends obliquely upward to the front from the crankcase such that an axis of the cylinder extends obliquely in an upward direction, the sub-frames are bent convexly downward, and front side portions further on the front side than the bent portions in the sub-frames extend substantially parallel to the axis of the cylinder.

[0033] Consequently, since the front side portions of the

sub-frames extend along the cylinder of the internal combustion engine, it is possible to arrange the front side portions of the sub-frames in positions near the cylinder. Thus, it is possible to reduce height of the sub-frames and keep the body cover covering the sub-frames low.

[0034] It is preferable that the cylinder extends obliquely upward to the front from the crankcase such that the axis of the cylinder extends obliquely in the upward direction, the sub-frames are bent convexly downward, and the bent portions of the sub-frames are located above a boundary portion of the cylinder and the crankcase in the internal combustion engine.

[0035] Consequently, since the sub-frames are arranged along the cylinder and the crankcase of the internal combustion engine, in setting the sub-frames and the internal combustion engine, efficient use of a space is realized. Since it is possible to arrange the sub-frames in positions near the combustion engine, it is possible to keep the body cover covering the sub-frames low.

[0036] Another saddle-riding type vehicle according to the invention includes: a head pipe that supports a steering shaft to rotationally move freely; a body frame including a main frame that is connected to the head pipe and extends obliquely downward to the rear and a pair of left and right sub-frames that are connected to the main frame and extend obliquely downward to the rear; and a motor supported in positions of

two places separated in a front to rear direction in the respective sub-frames in a suspended state.

[0037] According to the saddle-riding type vehicle, the motor serves as a reinforcing member and the sub-frames are reinforced at least in the two places separated to the front and the rear. Thus, it is possible to keep strength of the sub-frames themselves low because the sub-frames are reinforced by the motor. Therefore, it is possible to realize a reduction in a size or a reduction in weight of the body frame while maintaining strength of the body frame.

[0038] It is preferable that the motor consists of an internal combustion engine including a crankcase and a cylinder that extends forward or obliquely upward to the front from the crankcase, the cylinder is supported by the main frame, and the crankcase is supported by the sub-frames.

[0039] Consequently, since the cylinder located on a front side of the motor is supported by the main frame and the crankcase located on a rear side of the motor is supported by the sub-frames, the motor is supported by the main frame and the sub-frames in a well-balanced state. Thus, it is possible to form the main frame and the sub-frames in appropriate lengths and form the main frame relatively short. Therefore, it is possible to realize a reduction in a size or a reduction in weight of the body frame while security strength of the body frame.

[0040] Still another saddle-riding type vehicle according to the invention is a saddle-riding type vehicle including: a head pipe that supports a steering shaft to rotationally move freely; a body frame that extends obliquely downward to the rear from the head pipe; and a motor supported by the body frame in a suspended state. The body frame includes at least a pair of left and right side frames and the saddle-riding type vehicle includes: a rear wheel; rear arms that support the rear wheel and extend substantially in a front to rear direction; left and right brackets fixed to the left and the right side frames, respectively; and a pivot shaft that pierces through both the brackets, both the rear arms, and the motor and attaches both the rear arms and the motor to both the brackets in a state in which the left and the right brackets are interposed between the left and the right rear arms and the motor, respectively.

[0041] According to the saddle-riding type vehicle, the brackets fixed to the left and the right frames are interposed between the motor and the left and the right rear arms, respectively. Thus, it is possible to reduce an interval between the left and the right brackets compared with a case in which the brackets are provided on an outer side of the motor and the rear arms. Therefore, it is possible to reduce intervals on the left and the right of the side frames and realize a reduction in width of the vehicle.

[0042] The body frame may include a main frame that is connected

to the head pipe and extends obliquely downward to the rear and a pair of left and right sub-frames that are connected to the main frame and extend obliquely downward to the rear. The side frames may consist of the sub-frames.

[0043] Consequently, the motor functions as a reinforcing member to increase strength of the sub-frames. Thus, it is possible to realize a reduction in a size or a reduction in weight of the frames.

[0044] It is preferable that a part of the motor is supported by the main frame.

[0045] Consequently, since the motor functions as the reinforcing member, strength of the main frame is increased. Thus, it is possible to realize a further reduction in a size or reduction in weight of the body frame.

Advantages of the Invention

[0046] As described above, according to the invention, since the motor is supported by the main frame and the left and the right sub-frames, it is possible to use the motor as the reinforcing member. Thus, it is possible to realize a reduction in a size and a reduction in weight of the body frame while maintaining strength of the body frame.

[0047] If the motor is supported in positions of two places in the front and the rear of the left and the right sub-frames, it is possible to reinforce the two places in the front and the rear of the sub-frames with the motor and realize a

reduction in a size and a reduction in weight while maintaining strength of the body frame.

[0048] If left and the right brackets fixed to a pair of left and right side frames, respectively, are interposed between the motor and the left and the right rear arms, respectively, and then the motor and the left and the right rear arms are attached to the brackets together, it is possible to reduce an interval between the left and the right side frames and realize a reduction in width of the vehicle.

Brief Description of the Drawings

[0049] Fig. 1 is a schematic side view of a motorcycle according to an embodiment of the invention.

Fig. 2 is a perspective view of a motor cycle according to the embodiment of the invention.

Fig. 3 is a sectional view along line A-A in Fig. 1.

Fig. 4 is a sectional view along line B-B in Fig. 1.

Description of Reference Numerals and Signs

[0050] 10 Motorcycle

11 Body frame

12 Engine (Motor, Internal combustion engine)

12a Cylinder

12b Crankcase

15 Head pipe

19 Main frame

20 Sub-frames

26 Rear arms

28 Brackets

29 Pivot shaft

Best Mode for carrying out the Invention

[0051] An embodiment of the invention will be hereinafter explained on the basis of the drawings.

[0052] As shown in Fig. 1, a saddle-riding type vehicle according to the embodiment is a motorcycle 10 of a so-called underbone type. The motorcycle 10 includes a body frame 11 forming a skeleton and an engine 12 supported by the body frame 11 in a suspended state.

[0053] A head pipe 15 is provided at a front end of the body frame 11. A not-shown steering shaft is inserted into the head pipe 15 to rotate freely. A not-shown front fork is provided on a lower side of the steering shaft. A front wheel 18 is supported by the body frame 11 to be capable of moving rotationally via the front fork and the like.

[0054] One main frame 19 is fixed to the head pipe 15. The main frame 19 extends obliquely downward to the rear from the head pipe 15. In order to secure sufficient strength, the main frame 19 is formed relatively thick and a section of the main frame 19 is formed in a hollow rectangular shape. In this embodiment, the main frame 19 is constituted by assembling a

pair of left and right beam-shaped members. Specifically, the main frame 19 includes a pair of left and right beam-shaped members that extend obliquely downward to the rear and are bent 90 degrees at both top and bottom ends. The main frame 19 is constituted by joining bent portions of the left and the right beam-shaped members in a left to right direction. However, it goes without saying that a method of forming the hollow main frame 19 is not limited at all and other forming methods may be used.

[0055] A cross-sectional area of the main frame 19 is different at a front end 19c and at a rear end 19b connected to the head pipe 15. The cross-sectional area of the main frame 19 is larger at the front end 19c than the rear end 19b and changes along a longitudinal direction of the main frame 19. Note that the cross-sectional area of the main frame 19 may change continuously along the longitudinal direction of the main frame 19 or may change stepwise.

[0056] A gusset 27 is fixed to a lower side of a front half portion of the main frame 19. The gusset 27 is arranged to be laid over between the main frame 19 and the head pipe 15.

[0057] A bracket 22 is fixed to a lower side of the rear end 19b of the main frame 19. A cylinder 12a of the engine 12 is attached to the bracket 22 via a bolt and a nut. In other words, the cylinder 12a of the engine 12 is supported by the main frame 19 via the bracket 22.

[0058] The engine 12 is a water-cooled engine. The engine 12 includes the cylinder 12a and a crankcase 12b. The cylinder 12a extends obliquely upward to the front from the crankcase 12b. The cylinder 12a includes a cylinder block and a cylinder head attached to an upper side of the cylinder block. The cylinder 12a is supported in a posture with an axial direction of the cylinder 12a and a longitudinal direction of the main frame 19 substantially parallel to each other.

[0059] A carburetor 13 is disposed behind the cylinder 12a. The carburetor 13 is arranged near a lower side of the rear end 19b of the main frame 19, that is, on an extension line to the rear of the main frame 19. An air cleaner 21 that purifies the outside air and supplies the outside air to the carburetor 13 is disposed on a rear side of the carburetor 13. The air cleaner 21 is arranged in a position near the carburetor 13, that is, a position adjacent to the carburetor 13. The air cleaner 21 assumes substantially a rectangular parallelepiped shape. As shown in Fig. 1, the air cleaner 21 is arranged obliquely such that an upper end side thereof is positioned further in the front of the vehicle than a lower end side thereof.

[0060] A battery 34 is arranged behind and above the air cleaner 21. The battery 34 is located on a lower side of a seat 36 to be maintained by opening the seat 36.

[0061] In this way, since the air cleaner 21 is arranged near

the rear of the carburetor 13, an air intake passage is made linear and simplified. Thus, it is possible to improve performance of the engine 12. The air cleaner 21 and the battery 34 are relatively large components. When the air cleaner 21 and the battery 34 are arranged in a vehicle width direction, a vehicle width tends to be large. However, in the motorcycle 10, since the air cleaner 21 and the battery 34 are arranged in a front to rear direction of the vehicle, it is possible to control the vehicle width and reduce width of the vehicle. Moreover, since the air cleaner 21 is arranged in a tilted posture, it is possible to effectively use a space on a lower side of the battery 34 as a part of a space for setting the air cleaner 21. Therefore, it is possible to control length in the front to rear direction of the vehicle and height of the vehicle while securing a capacity of the air cleaner 21.

[0062] A fuel tank 35 is disposed behind the battery 34 and below the seat 36.

[0063] A radiator 24 that cools cooling water supplied to the engine 12 is arranged above the cylinder 12a of the engine 12 and below the main frame 19. A not-shown bracket is provided in the gusset 27. The radiator 24 is supported by the body frame 11 via the bracket.

[0064] Incidentally, in the vehicle of the underbone type, that is, a vehicle in which the main frame 19 inclines obliquely downward at a relatively steep angle, there is a problem

described below concerning a space for setting the radiator 24. In the vehicle of the underbone type, when it is attempted to arrange the radiator 24 below the main frame 19 and above the cylinder head, a space for setting the radiator 24 is relatively limited. Thus, in the motorcycle 10, a lower edge 27a of the gusset 27 is bent to be recessed upward. In other words, the lower edge 27a of the gusset 27 is bent to escape upward. Consequently, the space for setting the radiator 24 increases to prevent contact of the gusset 27 and the radiator 24. In other words, since the lower edge 27a of the gusset 27 is bent upward, the gusset 27 and the radiator 24 are less likely to interfere with each other. It is possible to efficiently arrange the gusset 27 in a limited space. Since this makes it possible to arrange the gusset 27 with a suitable size in a suitable position, it is possible to improve strength of the main frame 19.

[0065] As shown in Fig. 2, sub-frames 20 are fixed to both side portions 19a on the left and the right of the main frame 19. Specifically, a pair of sub-frames 20 are provided on the left and the right and front ends 20a of the respective sub-frames 20 are fixed near the center in the longitudinal direction of the main frame 19. Most parts of the sub-frames 20 assume a round pipe shape. A section of the sub-frames 20 is formed smaller than a section of the main frame 19. A shape of the front ends 20a of the sub-frames 20 is changed from the pipe

shape to the planar shape toward a front side thereof. Portions of the planar shape are joined to the side portion 19a of the main frame 19 by welding or the like in a state in which the portions are in surface contact with the side portion 19a.

[0066] The sub-frames 20 have a bent structure. Specifically, as shown in Fig. 1, substantially the center in the longitudinal direction of the sub-frames 20 is bent to be projected downward. Bent portions 20b are located above a boundary portion of the crankcase 12b and the cylinder 12a of the engine 12. Front side portions 20c further on the front side than the bent portions 20b extend substantially parallel to an axial direction of the cylinder 12a of the engine 12. Rear side portions 20d further on a rear side than the bent portions 20b are inclined more gently than the front side portions 20c.

[0067] Brackets 23 are fixed to rear side portions 20d (portions near the rear of the bent portions 20b) of the sub-frames 20. The crankcase 12b of the engine 12 is attached to the brackets 23 via a bolt and a nut.

[0068] The rear side portions 20d of the sub-frames 20 extend to the rear of the engine 12. Brackets 28 are fixed to rear ends 20e of the rear side portions 20d of the sub-frames 20. Both the crankcase 12b of the engine 12 and rear arms 26 are supported by the brackets 28.

[0069] Specifically, as shown in Fig. 1, the brackets 28 made of metal extending downward, respectively, are fixed to the

rear ends 20e of the pair of left and right sub-frames 20. A pivot shaft 29 is suspended between the brackets 28. As shown in Fig. 3, a bolt head 29a is provided at one end of the pivot shaft 29 and a male thread portion 29b is formed at the other end. The male thread portion 29b is screwed in a nut 30. The crankcase 12b of the engine 12 and front end cylindrical portions 26a of the rear arms 26 are supported by the pivot shaft 29 supported by the brackets 28.

[0070] Specifically, as shown in Fig. 3, on the left side of the engine 12, the front end cylindrical portion 26a of the rear arm 26 on the left side is arranged between the bolt head 29a of the pivot shaft 29 and the bracket 28. The front end cylindrical portion 26a is supported by the pivot shaft 29 via a bush 38 with internal and external cylinders and is capable of rotationally moving around the pivot shaft 29 within a predetermined angle range. The bush 38 with internal and external cylinders includes an inner cylinder 38a and an outer cylinder 38c made of iron and an intermediate cylinder 38b made of rubber interposed between the inner cylinder 38a and the outer cylinder 38c. The pivot shaft 29 is inserted into the inner cylinder 38a and the outer cylinder 38c is pressed into the front end cylindrical portion 26a of the rear arm 26. Consequently, when the front end cylindrical portion 26a of the rear arm 26 rotationally moves around the pivot shaft 29, the intermediate cylinder 38b made of rubber of the bush 38

with internal and external cylinders is elastically deformed to allow rotational movement of the rear arm 26 and regulate rotational movement of the rear arm 26 exceeding a predetermined range.

[0071] The front end cylindrical portion 26a is also provided in the rear arm 26 on the right side of the engine 12. The front end cylindrical portion 26a is arranged between the bracket 28 on the right side and a washer 33 on the nut 30 side. The front end cylindrical portion 26a of the rear arm 26 on the right side is also supported to rotationally move freely by the pivot shaft 29 via the bush 38 with internal and external cylinders and rotationally moves in the predetermined angle range.

[0072] Moreover, the crankcase 12b of the engine 12 is held between the pair of left and right brackets 28, 28. A through-hole 12c extending to the left and the right is formed in the crankcase 12b and the pivot shaft 29 is inserted through the through-hole 12c. With such a constitution, the crankcase 12b is supported by the pivot shaft 29.

[0073] The crankcase 12b of the engine 12, the left and the right brackets 28, and the left and the right inner cylinders 38a are integrally combined by screwing the male thread portion 29b of the pivot shaft 29 in the nut 30. The inner cylinder 38a on the right side is held between the bracket 28 on the right side and the nut 30 portion (accurately, the washer 33).

The inner cylinder 38a on the left side is held between the bracket 28 on the left side and the bolt head 29a.

[0074] As described above, the engine 12 is attached to the bracket 22 fixed to the main frame 19 and the brackets 23 and the brackets 28 fixed to the left and the right sub-frames 20 (see Fig. 1). In this way, the engine 12 is suspended in a position of one place on the main frame 19 side and suspended in positions of two places separated to the front and the rear in the left and the right sub-frames 20. As a result, the engine 12 is supported in a state in which the engine 12 is laid over between both the frames 19 and 20. Both the frames 19 and 20 are disposed in a state in which the frames 19 and 20 are astride the engine 12.

[0075] One ends of seat rails 31 are connected to the rear side portions 20d of the sub-frames 20. Specifically, front ends 31a of the seat rails 31 are welded in substantially the center in the longitudinal direction in the rear side portions 20d of the sub-frames 20 (a position between both the brackets 23 and 28). Front ends 32a of back stays 32 are welded to the rear ends 20e of the rear side portions 20d of the sub-frame 20. The seat rails 31 and the back stays 32 constitute a rear side frame extending obliquely upward to the rear and are formed in a round pipe shape, respectively. However, shapes of the seat rails 31 and the back stays 32 may be other shapes such as a square pipe shape. A material of the seat rails 31 and

the back stays 32 may be iron, aluminum, and the like. Rear ends 32b of the back stays 32 are connected to intermediate portions of the seat rails 31.

[0076] As shown in Fig. 2, a cross member 40 extending in the vehicle width direction is fixed to the pair of left and right seat rails 31. The cross member 40 is laid over between the left and the right seat rails 31. A cross member 41 extending in the vehicle width direction is also laid over between a pair of left and right extended portion 26b in the rear arms 26. The cross member 41 is made of a pipe-like member that extends in substantially a U-shape. Both ends of the pipe-like member are joined to the extended portion 26b.

[0077] A rear cushion 42 is disposed between the cross member 40 and the cross member 41. An upper end 42a of the rear cushion 42 is coupled to the cross member 40 on the seat rails 31 side to rotationally move freely. A lower end 42b of the rear cushion 42 is coupled to the cross member 41 on the rear arms 26 side to rotationally move freely. In the motorcycle 10, vibration from the rear wheel 25 is absorbed by the rear cushion 42.

[0078] As shown in Fig. 1, a leg shield 37 covering upper sides of the main frame 19 and the left and the right sub-frames 20 is disposed in front of the seat 36 (see Fig. 4 as well).

[0079] The constitution of the motorcycle 10 according to the embodiment is as described above.

[0080] In this way, in the motorcycle 10, the engine 12 is fixed to be laid over between the main frame 19 and the sub-frames 20. Thus, the engine 12 also functions as a reinforcing member for the body frame 11. Therefore, it is possible to realize a reduction in a size and a reduction in weight of the body frame 11 while maintaining strength of the vehicle.

[0081] As shown in Fig. 4, according to the motorcycle 10, it is possible to form the sub-frames 20 in a thin round pipe shape. Thus, it is possible to keep a center tunnel portion 37a of the leg shield 37 in front of the seat 36 low. In other words, as indicated by an alternate long and two short dashes line in Fig. 4, when the sub-frames 20 are formed of relatively thick square pipes in order to increase strength, since positions of upper surfaces of the square pipes are elevated, a position of the leg shield 37 is also elevated as indicated by an alternate long and two short dashes line in the figure. On the other hand, in the motorcycle 10, since the sub-frames 20 are formed of a round pipe and thickness of the sub-frames 20 is reduced, it is possible to reduce height of the leg shield 37.

[0082] According to the motorcycle 10, connecting positions of the sub-frames 20 and the main frame 19, that is, positions of the front ends 20a of the sub-frames 20 are ahead of a supporting portion of the engine 12 in the main frame 19, that is, a position of the bracket 22. In this way, since the front

ends 20a of the sub-frames 20 are connected ahead of the supporting portion of the engine 12 (a portion where the bracket 22 is disposed) in the main frame 19, a portion between the front end 19c of the main frame 19 and the supporting portion is reinforced by the sub-frames 20. Thus, it is possible to increase strength of the main frame 19. It is possible to effectively increase strength of the main frame 19 by contriving a connecting position of the sub-frames 20 according to a necessary strength distribution of the main frame 19.

[0083] The main frame 19 is formed thicker at the front end 19c than the rear end 19b. Thus, on the front end 19c side connected to the head pipe 15, it is possible to secure strength against bending moment sufficiently. On the other hand, it is possible to form the rear end 19b side thin. Since it is possible to form the rear end 19b side thin in this way, it is possible to keep the center tunnel portion 37a of the leg shield 37 low.

[0084] The cylinder 12a of the engine 12 is supported by the main frame 19 having large strength. Thus, it is possible to reduce length of the main frame 19 compared with a case in which the cylinder 12a of the engine 12 is supported by the sub-frames 20. Therefore, it is possible to realize a reduction in weight of the body frame 11 while securing necessary strength.

[0085] The cylinder 12a of the engine 12 is supported by, in particular, a portion near the rear end of the main frame 19,

that is, the rear end 19b. Thus, it is possible to reduce length of the main frame 19 and realize a further reduction in weight of the body frame 11.

[0086] The front side portions 20c of the sub-frames 20 extend substantially in parallel to the axial direction of the cylinder 12a of the engine 12. Thus, it is possible to effectively bring the front side portions 20c of the sub-frames 20 close to the cylinder 12a. As a result, it is possible to reduce height of the sub-frames 20. Therefore, it is possible to keep the center tunnel portion 37a of the leg shield 37 low.

[0087] The cylinder 12a of the engine 12 extends obliquely upward from the crankcase 12b. The engine 12 is formed in a shape bending upward as a whole. The bent portions 20b of the sub-frames 20 are located above the boundary portion of the cylinder 12a of the engine 12 and the crankcase 12. Thus, the sub-frames 20 are arranged along the bent shape of the engine 12. Therefore, since it is possible to arrange the sub-frames 20 in positions near the engine 12, it is possible to keep the center tunnel portion 37a of the leg shield 37 lower.

[0088] According to the motorcycle 10, middle portions of the sub-frames 20 are bent to be recessed downward. The engine 12 is supported near the bent portions 20b of the sub-frames 20. Thus, it is possible to reinforce strength in the bent portions 20b of the sub-frames 20 with the engine 12. Moreover, it is possible to keep the center tunnel portion 37a of the

leg shield 37 lower.

[0089] According to the motorcycle 10, the seat rails 31 extending obliquely upward to the rear is fixed to the rear side portions 20d further on the rear side than the bent portions 20b of the sub-frames 20. Consequently, the sub-frames 20 are reinforced. Therefore, it is possible to reduce a diameter of the sub-frames 20 while securing strength of the entire body frame 11 and keep the center tunnel portion 37a of the leg shield 37 lower.

[0090] According to the motorcycle 10, the portions further on the rear side than the bent portions 20b of the sub-frames 20 extend to the rear of the engine 12. Both the engine 12 and the rear arms 26 are supported by the rear ends 20e of the sub-frames 20 via the brackets 28. Consequently, it is possible to simplify a supporting structure for the engine 12 and the like and reduce a size of the brackets 28.

[0091] The front ends 31a and 32a of the seat rails 31 and the back stays 32 extending obliquely upward to the rear are fixed to the rear ends 20e of the sub-frames 20. The seat rails 31 and the back stays 32 are connected to each other on the rear end sides thereof. Consequently, it is possible to reduce a diameter of the sub-frames 20 while securing strength of the body frame 11 and keep the center tunnel portion 37a of the leg shield 37 lower.

[0092] The engine 12 is supported by portions near the

connecting portions of the seat rails 31 and the back stays 32 in the sub-frames 20. Consequently, since the engine 12 is supported by portions having high strength in the sub-frames 20, it is possible to reduce thickness of the sub-frames 20 while securing strength of the body frame 11.

[0093] The engine 12 is supported by the main frame 19 via the bracket 22 and supported by portions of two places separated to the front and the rear of the respective sub-frames 20 via the brackets 23 and the brackets 28. Thus, the engine 12 is supported by the main frame 19 and the sub-frames 20 in a well-balanced state. The function of the engine 12 as a reinforcing member is improved to make it possible to obtain larger strength compared with a case in which the engine 12 is supported by one portion of the sub-frames 20.

[0094] The pair of sub-frames 20 are provided on the left and the right, respectively. The pair of brackets 28 provided in the left and the right sub-frames 20 are interposed between the rear arms 26 supporting the rear wheel 25 and the engine 12 (see Fig. 3). Thus, it is possible to control an increase in an interval between the left and the right sub-frames 20 and reduce a width of the vehicle while maintaining strength of the body frame 11.

[0095] Incidentally, when it is assumed that the brackets 28 are disposed on an outer side of the rear arms 26 and the inner cylinders 38a of the bush 38 with internal and external

cylinders are directly in contact with the crankcase 12b of the engine 12, it is likely that the inner cylinders 38a made of iron cut into the crankcase 12b made of aluminum because of tightening of the nut 30 at the time of assembly. In that case, in order to prevent the inner cylinders 38a from cutting into the crankcase 12b, it is necessary to dispose washers between the inner cylinders 38a and the crankcase 12b. However, in the motorcycle 10, the tabular brackets 28 made of iron are interposed between the inner cylinders 38a made of iron and the crankcase 12b made of aluminum. Thus, when the nut 30 is tightened, the inner cylinders 38a never cut into the crankcase 12b side. Therefore, since it is unnecessary to provide washers, it is possible to reduce the number of components.

[0096] Note that, in the motorcycle 10 according to the embodiment, the pair of sub-frames 20 formed symmetrically are provided as the pair of left and right sub-frames. However, the pair of left and right sub-frames only have to be provided on the left and the right of the vehicle and do not always have to be formed symmetrically.

[0097] The motorcycle 10 according to the embodiment includes the engine 12, which serves as an internal combustion engine, as the "motor". However, it goes without saying that the motor is not limited to the engine 12 and may be other motors such as an electric motor. The saddle-riding type vehicle according to the invention is not limited to the motorcycle

10.

Industrial Applicability

[0098] As described above, the invention is useful for the saddle-riding type vehicle such as a motorcycle.